

I claim

1. An apparatus for generating a plurality of charged particle beamlets, comprising:

-a charged particle source for generating a diverging charged particle beam;  
-a converging means for refracting said diverging charged particle beam;  
-a lens array comprising a plurality of lenses, located between said charged particle source and said converging means.

2. The apparatus according to claim 1, wherein the converging means is adapted for refracting a diverging charged particle beam into a substantially parallel charged particle beam for generating a plurality of substantially parallel charged particle beamlets.

3. The apparatus according to claim 1, wherein said charged particle source is arranged in a focal plane of said converging means.

4. The apparatus according to claim 1 or 3, wherein the lens array is arranged to project images of said source in the principal plane of said converging means.

5. The apparatus according to claim 1, furthermore provided with splitting means for splitting said charged particle beam in a plurality of charged particle beamlets.

6. The apparatus of claim 5, wherein said splitting means comprises a spatial filter.

7. The apparatus of claim 6, wherein said splitting means comprises an aperture array.

8. The apparatus of claim 6 or 7, wherein said spatial filter is located between said charged particle source and said lens array to split up said diverging charged particle beam into a plurality of charged particle beamlets.

9. The apparatus of claim 7, wherein said spatial filter is concave with respect to said source.

10. The apparatus of claim 9, wherein the curvature of said spatial filter has its focal point substantially in the origin of the charged particle beam.

5 11. The apparatus of claim 1, wherein said lens array is concave with respect to said source.

12. The apparatus of claim 11, wherein the curvature of said lens array has its focal point substantially in the origin of the charged particle beam.

10

13. The apparatus of claim 5, wherein said splitting means is aligned with said lens array for providing each lens with an individual beamlet.

15

14. The apparatus of claim 1, wherein the charged particle beam is an electron beam and said lens array is an array of electrostatic lenses.

20

15. The apparatus according to claim 1, wherein said lens array comprises an aperture plate, and means for defining an equipotential surface substantially parallel to said aperture plate at a distance from said aperture plate at a different potential than said aperture plate itself.

16. The apparatus of claim 15, wherein the aperture plate has an electrically conducting surface and means for defining the electrostatic potential of said surface.

25

17. The apparatus of claim 16, wherein said means for defining an equipotential surface comprises a plate having a through hole at the location of the beam of beamlets, in particular a circular hole having its center at the optical axis of the charged particle beam.

30

18. The apparatus of claim 17, wherein said means for defining an equipotential surface are located between said source and said lens array.

19. The apparatus of claim 17, wherein said means for defining an equipotential surface

are located between said array of converging elements and said converging means.

20. The apparatus according claim 1, wherein said converging means comprises at least one deflector array with deflectors aligned with the beamlets.

5

21. The apparatus of claim 20, wherein said converging means further comprises a controller for applying different voltages to the different deflectors of said deflector array.

10

22. The apparatus of claim 21, wherein said controller is adapted for applying voltages to each deflector of said deflector array for deflecting a beamlet, with the controller adapted for setting the voltages to have each deflector assert a deflecting effect proportional to the distance of a deflector with respect the optical axis of the beam.

15

23. The apparatus of claim 21, wherein said controller is adapted for applying voltages to each deflector of said deflector array for deflecting a beamlet, with the controller adapted for setting the voltages to have each deflector assert a deflecting effect sufficient for compensating aberrations of further converging devices of the converging means.

20

24. The apparatus according to claim 1, wherein said converging means is an electrostatic lens.

25. The apparatus according to claim 24, wherein said lens array comprises an end plate providing a first electrode in said electrostatic lens.

25

26. The apparatus according to claim 25, further provided with a second controller for applying a voltage to the electrodes of said electrostatic lens for operating said electrostatic lens substantially free of spherical aberration.

30

27. An apparatus for generating a plurality of charged particle beamlets, comprising:

- a charged particle source for generating a diverging charged particle beam;
- a converging means for refracting said diverging charged particle beam, said converging means having a collimation plane;

-a lens array comprising a plurality of lenses, positioned with respect to said converging means with lens of said lens array projecting an image of said source on said collimation plane.

5        28. The apparatus of claim 1 or 27, wherein said charged particle beam is an electron beam.

29. The apparatus of claim 1 or 27, wherein said charged particle beam is an ion beam.

10       30. A charged particle beam lithography system comprising the apparatus of claims 1 or 27.

31. A substrate processed with the charged particle beam lithography system of claim 30.

15       32. A charged particle beam microscopy system comprising the apparatus of claims 1 or 27.

-O-O-O-O-O-O-O-

PvE